CLAIMS

1. A receiver front end capable of receiving electromagnetic wave signals having frequencies in the range of substantially 35GHz to substantially 40GHz, and having a gain of substantially 24dB or above and a noise figure of substantially 4dB or below, and comprising one or more multifunction monolithic microwave integrated circuits (MMICs).

2. A receiver front end according to claim 1 which has a noise figure of substantially 4dB or below over an output signal frequency range of substantially 1 to 10GHz.

3. A receiver front end according to any preceding claim in which the or each multifunction receiver front end MMIC carries out a plurality of functions and the functions comprise amplification of the electromagnetic wave signals received by the MMIC, and/or filtering the electromagnetic wave signals, and/or conversion of the frequency or frequencies of the electromagnetic wave signals to a lower or higher frequency or frequencies, and/or amplification of the converted signals.

4. A receiver front end according to any preceding claim which comprises a receiver MMIC and a doubler/buffer amplifier MMIC, and in which the receiver MMIC comprises a low noise amplifier (LNA), with a noise figure less than 4dB.

5. A receiver front end according to claim 4 in which the LNA is a balanced amplifier, and each electromagnetic signal received by the LNA is split into two substantially symmetric signals, each of which is fed into a separate amplification section.

6. A receiver front end according to claim 5 in which each amplification section of uses three stages of amplification, and the output of each amplification section is combined and the combined signal output from the LNA.

7. A receiver front end according to any of claims 4 to 6 in which the receiver MMIC comprises a mixer, and in which the mixer converts the frequency of a signal output from the LNA to a lower frequency mixer output signal.

8. A receiver front end according to claim 7 in which the mixer comprises two diodes and the signal from the LNA is fed into the diodes along with a reference signal and the diodes multiply the signal from the LNA and the reference signal and output a signal having a frequency equal to the difference in frequency of the signal from the LNA and the frequency of the reference signal.

9. A receiver front end according to any of claims 7 to 8 in which the mixer is a 90° balanced mixer.

10. A receiver front end according to any of claims 4 to 9 in which the receiver MMIC comprises a filter, and the filter is placed between the LNA and the mixer, to filter the signal from the LNA before it is fed to the mixer.

11. A receiver front end according to claim 10 in which the passband of the filter is such that it suppresses a sideband of the signal from the LNA.

12. A receiver front end according to any of claims 10 to 11 in which the filter comprises a distributed transmission line design, in which the filter is folded into a serpentine layout.

13. A receiver front end according to any of claims 4 to 12 in which the

receiver MMIC comprises an IF amplifier, and the IF amplifier receives an IF output signal from the mixer and amplifies it producing an IF output signal which is output from the receiver MMIC.

14. A receiver front end according to claim 13 in which the amplifier comprises a single transistor stage, and in which a parallel resistor-inductor-capacitor feedback network is applied between the gate and drain terminals of the transistor.

15. A receiver front end according to any of claims 4 to 14 in which the doubler/buffer amplifier MMIC is placed between the LO and the mixer, and the doubler/buffer amplifier MMIC receives the reference signal produced by the LO, and doubles the frequency of this signal producing a new reference signal which is fed to the mixer.

16. A receiver front end according to claim 15 in which the doubler/buffer amplifier MMIC comprises a filter component comprising two quarter wavelength open circuit stubs.

17. A receiver front end package comprising a receiver front end according to any of claims 1 to 16, power supply components for the receiver front end, and connectors for the receiver and the power supply components.

18. A receiver front end package according to claim 17 which is double sided allowing isolation of the electromagnetic wave receiver front end and the power supply components into separate enclosures, and in which connections are made between the receiver front end and the power supply components using glass bead feedthroughs in the package floor.

19. A receiver front end package according to any of claims 17 to 18 in which

the power supply components comprise DC biasing circuits on a circuit board, and in which the biasing circuits contain bias sequencing and voltage regulation for all of the bias lines of the receiver front end.

20. A receiver front end package according to claim 19 in which the connectors are connected to the receiver front end using an airline launch technique, which allows easy insertion and removal of the receiver front end, and provides a better than 20dB impedance match of the connectors with the receiver front end.

21. A receiver front end package according to any of claims 17 to 20 in which the receiver front end package is connected to an antenna, which detects the electromagnetic waves.

22. A receiver front end package according to claim 21 in which the receiver front end package is mounted on the antenna or a movable component thereof and can move with the antenna.

23. A phased array system comprising a plurality of receiver front ends according to any of claims 1 to 16.

24. A high data rate communications system comprising one or more receiver front ends according to any of claims 1 to 16.